Eschede Train Disaster

Leadership ViTS Meeting
May 7, 2007

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In June of 1998, one of Germany’s InterCity Express (ICE) trains, traveling at over 200kph, slammed into an overpass, killing 101 people.

The accident happened to a high speed ICE train just outside the town of Eschede in northern Germany.

As the train was traveling to the Eschede Station, a wheel rim on a passenger coach peeled away from the wheel body, puncturing the floor, and becoming embedded underneath the car.

Passengers noticed the wheel rim when it came through the floor of the rail car.
- Policy required the train manager investigate the damage before stopping the train.
- No one activated the emergency brake.

The train traveled over 3 km before derailing.

Cars were crushed when an overpass, which was not designed to withstand impact of train derailment, collapsed.
Fatal Wheel “Improvement”

- First generation ICE trains were made with single-cast or “mono-block” wheels.

- That design could result in metal fatigue and out-of-round conditions which caused vibrations at cruising speeds.

- Based on heritage streetcar design, the mono-block wheel was modified to include a rubber damping ring 20mm thick between the metal wheel rim and the wheel body.
Proximate Causes in Event Chain

- Delamination of wheel rim
- Failure to stop immediately upon delamination of wheel rim

Causal Web – Underlying Issues

- Inadequate testing and design verification
  - The rubber cushioned wheels, which had been used successfully on streetcars, were not suitable for the heavier load of ICE trains operating at much higher speeds.
  - At the time, Germany did not have the facilities to adequately test such designs, so many of the wheel design decisions were based on analysis and theory rather than test data.
- Inadequate independent verification of analyses
- Failure to establish and follow necessary operational margins of safety and "acceptable" wear and tear limits
- Failure to consider external hazards in operating area
- Flawed emergency response policies and procedures
NASA Applicability

- Use of heritage hardware for a similar but fundamentally different operating environment
- Use of heritage software
  - Consider Ariane V, flight 501
- Design verification and the degree of testing necessary to adequately certify a design.
- Level of independent verification of analysis necessary to certify a design in cases where operational testing is impossible
  - Consider the extensive independent analyses and evaluation associated with certification of SSP Super Lightweight Tank
- Operating margins and the determination of acceptable wear and tear for operational systems (e.g., Space Shuttle).
- Adequacy of active safety monitoring/alert systems and emergency procedures
- Operational contingency planning or operational response to anomalous conditions.